CLAIMS

1. A tunable resonating arrangement comprising a resonator apparatus (10;100), input/output coupling (4;4C_{in},4C_{out}) means for coupling electromagnetic energy into/out of the resonator apparatus, and a tuning device (3) for application of a biasing voltage/electric field to the resonator apparatus,
c h a r a c t e r i z e d i n
that the resonator apparatus comprises a first resonator (1;1A;1B;1C;1D;1E) and a second resonator (2;2A;2B;2D;2E), that said first resonator is non-tunable, that said second resonator is tunable and comprises a ferroelectric substrate (21), that said first and second resonators are separated by a ground plane (13;13A;13B;13F) which is common for said first and second resonators, that coupling means (5;5A;5B;5C;5D;5E) are provided for providing coupling between said first and second resonators, and in that for tuning of the resonator apparatus, the biasing voltage/electric field is applied to the second resonator (2;2A;2B;2D;2E).

2. A tunable resonating arrangement according to claim 1,
c h a r a c t e r i z e d i n
that the first resonator, (1;1A;1B;1C;1D;1E) is a disk resonator, or a parallell plate resonator.

3. A tunable resonating arrangement according to claim 1 or 2,
c h a r a c t e r i z e d i n
that the second resonator (2;2A;2B;2D;2E) is a disk resonator, or a parallell plate resonator.

4. A tunable resonating arrangement according to claim 2 or 3,
c h a r a c t e r i z e d i n

that the first resonator comprises a dielectric substrate (11;11A;11B;11C), the electric permittivity of which substantially does not vary with applied biasing voltage, which is disposed between a first and a second electrode, and in that the second electrode of the first resonator forms the ground plane.

5. A tunable resonating arrangement according to claim 4, characterized in that the dielectric substrate (11;11A;11B;11C) of the first resonator comprises $LaAlO_3$, MgO, $NdGaO_3$, Al_2O_3, sapphire or a material with similar properties.

6. A tunable resonating arrangement according to claim 4 or 5, characterized in that the first resonator (1;1A;1B;1C;1D;1E) has a high quality factor (Q), e.g. 10^5 - $5 \cdot 10^5$

7. A tunable resonating arrangement according to any one of claims 4-6, characterized in that the second resonator (2;2A;2B;2D;2E) comprises a tunable ferroelectric substrate and a first (22;22A;22B) and a second electrode (13;13A;13B;13F), and in that the second electrode of the second resonator forms the common ground plane, and thus is the same as the second electrode of the first resonator.

8. A tunable resonating arrangement according to claim 7, characterized in that the ferroelectric substrate (21;21A;21B) of the second resonator comprises $SrTiO_3$, $KTaO_3$, $BaSTO_3$ or a material with similar properties.

9. A tunable resonating arrangement according to any one of claims 4-8,
c h a r a c t e r i z e d i n
that the first and second electrodes, i.e. the first electrodes and the common ground plane, consist of normal, non-superconducting metal, e.g. Au, Ag, Cu.

10. A tunable resonating arrangement according to any one of claims 4-8,
c h a r a c t e r i z e d i n
that the first and second electrodes, i.e. the first electrodes and the common ground plane, consist of a superconducting material.

11. A tunable resonating arrangement according to any one of claims 4-8 or 10,
c h a r a c t e r i z e d i n
that the first and second electrodes, i.e. the first electrodes and the common ground plane consist of a high temperature superconducting material (HTS), e.g. YBCO.

12. A tunable resonating arrangement according to any one of the preceding claims,
c h a r a c t e r i z e d i n
that upon the application of a tuning (biasing) voltage to said second resonator (2;2A;2B;2D;2E), electromagnetic energy (EM) will be redistributed between the second and first resonators via the coupling means (5;5A;5B;5C;5D;5E).

13. A tunable resonating arrangement according to claim 12,
c h a r a c t e r i z e d i n
that the distribution of electromagnetic energy depends on the biasing voltage.

14. A tunable resonating arrangement according to claim 13,
c h a r a c t e r i z e d i n
that the transfer of electromagnetic energy from the second resonator to the first resonator increases with an increasing biasing voltage.

15. A tunable resonating arrangement according to claim 10, 13 or 14,
c h a r a c t e r i z e d i n
that the resonating frequency and the loss tangent of the second resonator increase with the application of an increasing biasing voltage, and in that also the transfer of electromagnetic energy from the second to the first resonator is increased, automatically compensating for the increased loss tangent of the second resonator by reducing the influence thereof on the coupled resonator apparatus.

16. A tunable resonating arrangement according to claim 1,
c h a r a c t e r i z e d i n
that the first and second resonators comprise thin film substrates.

17. A tunable resonating arrangement according to any one of the preceding claims,
c h a r a c t e r i z e d i n
that it comprises at least two resonator apparatuses, and in that the common ground plane (13;13A;13B;13F) is common for the at least two resonator apparatuses which form a tunable filter (100).

18. A tunable resonating arrangement according to any one of the preceding claims,
c h a r a c t e r i z e d i n

that the coupling means comprises, for each resonator apparatus, a slot or an aperture (5;5A;5B;5C;5D;5E) in the common ground plane.

19. A tunable resonating arrangement according to any one of the preceding claims,
c h a r a c t e r i z e d i n
that each resonator is circular, square shaped, rectangular or ellipsoidal.

20. A tunable resonating arrangement according to claim 19,
c h a r a c t e r i z e d i n
that it comprises a dual mode resonator apparatus, and in that each resonator comprises a protrusion (6), a cut-out or a pertubation to provide for dual mode operation.

21. A tunable resonator apparatus,
c h a r a c t e r i z e d i n
that it comprises a first resonator and a second resonator, that said first resonator is non-tunable, that said second resonator is a tunable ferroelectric resonator, that said first and second resonators are separated by a ground plane which is common for said first and second resonators, that coupling means are provided for providing coupling between said first and second resonators, and in that for tuning of the resonator apparatus, a biasing voltage is applied to the second resonator.

22. A tunable resonator apparatus according to claim 21,
c h a r a c t e r i z e d i n
that the first resonator and the second resonator comprise parallell plate resonators, that the common ground plane is formed by a second electrode plate of the first resonator and of a second electrode of the second resonator, and in that the

coupling means comprises a slot or an aperture in the common ground plane.

23. A tunable resonator apparatus according to claim 22,
c h a r a c t e r i z e d i n
that the first resonator comprises a substrate, bulk or thin film, of $LaAlO_3$, MgO, $NdGaO_3$, Al_2O_3, sapphire, or a material with similar properties, and in that the second resonator comprises a substrate, bulk or thin film, of $SrTiO_3$, $KTaO_3$, or a material with similar properties, the electrode plates comprising normal metal, or (high temperature) superconductors.

24. A method of tuning a resonator apparatus,
c h a r a c t e r i z e d i n
that it comprises the steps of:
- providing a first, non-tunable, resonator,
- providing a second tunable resonator, such that the first and second resonators are separated by and share common ground plane,
- providing coupling means in said common ground plane such that the first and second resonators become coupled, allowing transfer of electromagnetic energy between the first and second resonators,
- applying a biasing/tuning voltage to said second resonator increasing the resonating frequency, the loss tangent of the second resonator, and the transfer of electromagnetic energy to the first resonator,
- optimizing the application of the biasing voltage such that the influence of the increased loss tangent in the first resonator, on the coupled resonator apparatus, will be compensated for, by an increased transfer of electromagnetic energy to the first resonator.

25. The method of claim 24,

c h a r a c t e r i z e d i n
that the first resonator and the second resonator comprise disk or parallell plate resonators, that the common ground plane is formed by a second electrode plate of the first resonator and of a second electrode of the second resonator, and in that the coupling means comprises a slot or an aperture in the common ground plane.

26. The method of any one of claims 24-25,
c h a r a c t e r i z e d i n
that the first resonator comprises a substrate, bulk or thin film, of $LaAlO_3$, MgO, $NdGaO_3$, Al_2O_3, sapphire, or a material with similar properties, and in that the second resonator comprises a substrate, bulk or thin film, of $SrTiO_3$, $KTaO_3$, or a material with similar properties, the electrode plates comprising normal metal, or (high temperature) superconductors.

27. The method of any one of claims 24-26,
c h a r a c t e r i z e d i n
that it comprises the step of:
- coupling two or more resonator apparatuses such that a filter is provided,
- optimizing the coupling between the respective first and second resonator such that the increasing loss factor produced by an increased biasing voltage, in the ferroelectric substrates, can be reduced.